GRAPHIC USER INTERFACE FOR CONSOLE SYSTEMS USING JAVA RMI FOR THE 1.8 GEV TSRF SYNCHROTRON RADIATION SOURCE

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Abstract

A graphic user interface (GUI) for consoles for the 1.8 GeV synchrotron radiation source at Tohoku Synchrotron Radiation Source (TSRF) has been developed using Java swing and Remote Method Invocation (RMI) running under the distributed platforms: Linux and/or windows platforms on a network. The consoles are used for controlling a synchrotron radiation source which are comprised of distributed computers (device servers) and equipment such as analogue-digital converters, digital input/output ports and VME CPUs. Experience with GUI using Java Swing and Remote Method Invocation for accessing remote equipment/devices as the distributed remote objects is discussed.

1 INTRODUCTION

TSRF (Tohoku-university Synchrotron Radiation Source Facility) is a new third generation synchrotron radiation source that is currently proposed at Tohoku University Japan [1] [2]. TSRF is planned to be constructed at the site of Laboratory of Nuclear Science, Tohoku University, where a 300MeV-Linac and 1.2GeV Stretcher Booster Ring are currently in operation for nuclear physics experiments. By taking advantage of the existing facility, TSRF employs the Stretcher Booster Ring as the injector for the TSRF storage ring. This can greatly reduce construction cost for the TSRF generation synchrotron radiation source. Table 1 shows principal parameters of the TSRF. Ten Wiggler/Undulator beamlines and five normal beamlines will be constructed for the first commissioning phase at TSRF as shown in Table 2. Fifty beamlines will be constructed in total in the future.

Table 1 Principal parameters of the synchrotron radiation source at TSRF

Beam Energy	1.8 GeV (Max. 2 GeV)
Circumference	244.8 m
Lattice	DBA×16
Straight Sections	5m x 14, 15m x 2
Emittance	4.9 nm-rad
RF Frequency	500 MHz
RF Voltage	1.0 MV
Beam Current	400 mA
Beam Lifetime	> 12 hr
Number of beamlines	50

Table 2 Wiggler/Undulator beamlines to be constructed for the first commissioning phase at TSRF

Research fields	Source
1. XAFS(high precision)	two Wigglers
2. XAFS (soft X-ray)	Bending M.
3. X-ray diffraction, topography	two Wigglers
4. X-ray small angle scattering	Wiggler
5. Atoms and molecules (VUV-SX)	Undulator
6. Surface-solid: PES/fluorescence	Undulator
7. Spin polarized UPS	Undulator
8. Far infrared	Bending M.
9. Millimetre-wave	IR wiggler
10. Soft X-ray optics/microscopy	Undulator
11. Lithography	Bending M.
12. Photochemical process	Bending M.
13. Radiation effect on biomaterials	Bending M.

2 SYSTEM CONFIGURATION

There are eleven consoles designed using Java Swing and RMI running under the distributed platforms on the network. The consoles and device servers are connected to a 100-Mbps network. Figure 1 shows the simplified block diagram of a console and a device server as an example. Communication between the console and the device server is done by RMI [3]. A console is an RMI client for a device server. Java programs run on the Virtual Machine (VM) that provides homogeneous environment on different platforms independent of their operating systems and hardware architecture. The VM has no direct interface to devices which are tightly implemented on specific operating systems. Thus those physical devices are not accessible to control applications. Java Native Interface (JNI) has been implemented for interface between physical devices and PCI device drivers provided by a PCI vendor which is a platform-dependent interface.

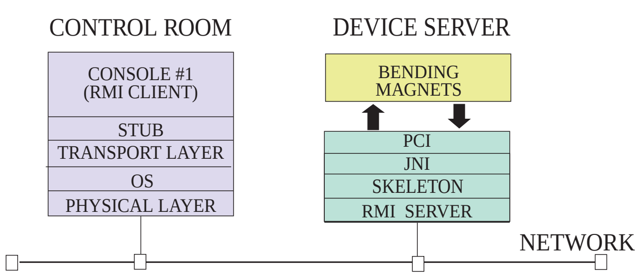

Figure 1: Simplified block diagram of a console and a device server using RMI communication for the 1.8GeV Synchrotron Radiation Source at TSRF

The consoles implemented are running under Linux or Windows for controlling device servers. Man-machine interfaces for the consoles, including graphic status displays providing menu driven interface were coded in Java swing graphics class libraries.

The control carries out the remote method as if it were a local method to control the remote device to be concerned. Thus any accelerator equipment on the network is transparent to the control programs.

The consoles are connected to device servers for the bending magnets, quadruple magnets, beam position monitors, wigglers, undulators and other accelerator components.

Figure 2 and 3 show screen shots of an operator console for magnet control, indicating currents in magnets of the storage ring. The currents in the magnets are acquired by calling remote methods of a control server for the power supplies through the network.

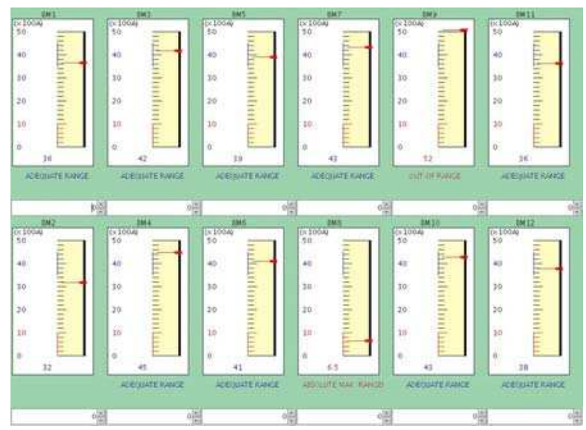

Fig. 2. Screen shot of an operator console for a magnet controller

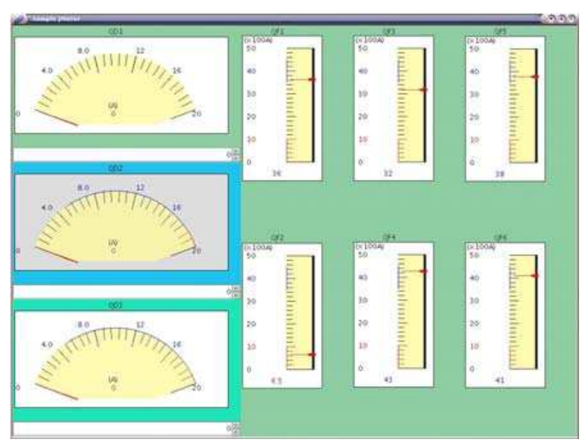

Fig. 3. screen shot of an operator console for quadruple magnets and some focusing/defocusing magnets.

Figure 4 shows a piece of screen shot of an operator console for emergency interlocks and summary status display for beamline status. From the left, beamline ID, summary status, status of experimental hall interlock, valve-open-request signal, valve status signals are depicted so that an operator can easily monitor the operation of the beamlines and the interlock status. The status of the beamlines is also acquired by calling remote methods of each control system for a beamline through the network. The emergency interlock display has a pop-up status window, providing precise information about cause of the error and its details. Information on interlocks and valves/shutters of accelerator components includes transitional event status. For example, for fifty beamlines, there are more than three-thousand event signal sources. To acquire such event data from device servers in a standard way, a console must continuously query the device servers by executing Java remote methods on the device server over the network, typically thousands times per second, causing high CPU load at the console. To reduce the CPU load and improve the performance, we have implemented asynchronous remote event notification system, and we have been using it [4].

Fig.4 A screen shot of an operator console for emergency interlocks and summary status display for the beamline status

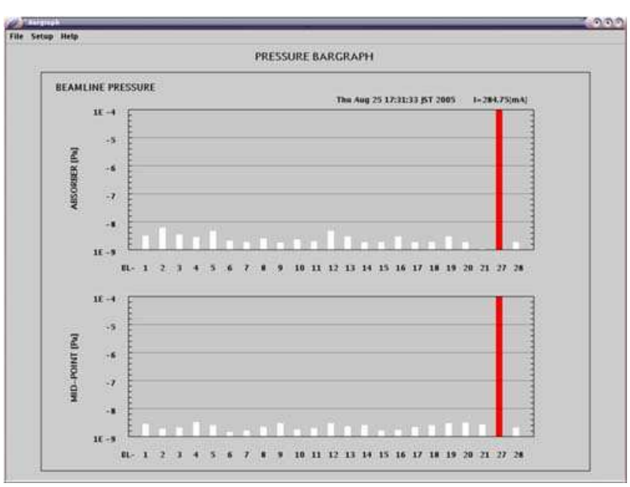

Fig.5 A screen shot of a console display for ultra-high vacuum of fifty beamlines

Figure 5 shows a screen shot of an operator console for ultra-high vacuum status of twenty two of fifty beamlines. The rest of beamline pressures are also displayed on different console screens. Each beamline has two ultra-high vacuum gauges which are accessible by calling remote methods of each control server for a beamline through the network. White bars indicate that pressures in the corresponding beamlines are in UHV range less than 10^{-9} [Pa]. As an example, a red bar indicates simulated incidental pressures rise over 10^{-5} [Pa].

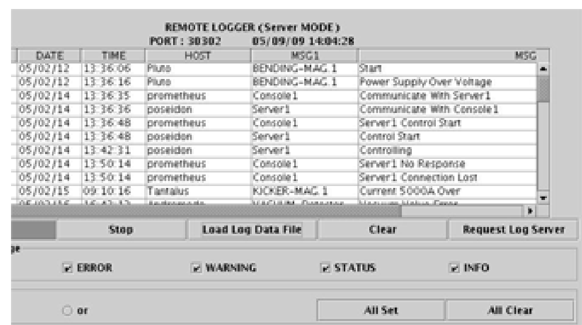

Fig. 6 System status logging display

Figure 6 shows a screen shot of a system status logging system which receives a system operational message with a time stamp from any client or server on the network. The system status logging system is used for identifying a cause of system error for the client-server systems on the network.

3 CONCLUSION

The graphic user interface for consoles using JAVA swing and RMI is discussed for the TSRF 1.8GeV storage ring. The consoles can remotely deal with PCI modules on remote Linux hosts control system.

4 ACKNOWLEDGEMENT

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